A Simple Approach for Identifying Underperforming Schools

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Abstract

This paper outlines a purely statistical approach for evaluating school performance within a district. Three performance criteria are detailed: absolute performance, relative performance and conditional performance. The criteria are applied to the Barbadian secondary school system. The study finds that when the three criteria are used in conjunction they can identify schools that are consistently good or poor performers. In the case of Barbados, there was a general improvement in secondary school performance over the period, with no single school appearing consistently on the list of underperformers.

Keywords: Performance; Secondary Schools; Statistical Approach

1. Introduction

Interest in improving school performance is intimately linked to the potential impact that a quality education system can have on a nation's GDP growth rate. In endogenous growth models, education impacts on growth since it lead to the accumulation of human capital, which is employed in the production of goods and services (Lucas, 1988; Romer 1990). Using a database of 86 countries averaged over 10 year intervals, Barro and Sala-i-Martin (2004) find a significant relationship between economic growth and the average years of male secondary and higher schooling. Moreover, once the quality of education is taken into account the marginal impact of education on the rate of economic growth rises. Sala-i-Martin, Doppelhofer and Miller (2003) also show that schooling is one of the few variables that are strongly or robustly related to growth.

Given the importance of the education, or the educational system, in terms of stimulating growth, a number of countries have implemented frameworks to identify and assist those schools that are underperforming. An underperforming school is one that is not performing up to the standards set by education officials. In England, the government sets annual performance targets for secondary schools, known as the DfES School and College Achievement and Attainment Tables, while the United States (under the No Child Left Behind Act of 2001) requires the Secretary of Education to transmit to the Committee on Education and the Workforce of the House of Representatives and the Committee on Health, Education, Labour, and Pensions schools that in need of improvement.

The traditional approach employed to identify underperforming schools is to specify some minimum level of achievement and use this as the benchmark. Therefore, any school falling below this benchmark is immediately red flagged as one that is under performing. This is the approach currently employed in the US. Each state establishes adequate yearly progress for each public primary and secondary school and district in state administered annual assessments. Those schools that do not meet the adequate yearly progress are identified as underperforming schools (US Department of Education, 2005). England employs a somewhat different approach, known as contextual value added (CVA), or more generally referred to as a composite indicator approach. The Department for Education and Skills (2006) uses a measure that adjusts predicted achievement to take account of not only prior attainment, but also a number of other factors outside of the school's control. Each students' performance is predicted based gender, special education needs, ethnicity, eligibility for free school meals, first language, mobility, age, in care and a post-code based deprivation measure. The difference between the students' predicted and actual attainment provides the CVA. The CVA scores for all the school's students is averaged and deflated based on the number of pupils. The CVA score is then employed to identify underperforming schools.

Both the benchmark and composite indicator approaches have their limitations. The main shortcoming of the benchmark approach is that they are usually based on subjective indicators of performance. Therefore, what is considered poor performance in one state or district might be considered average performance in another state or district. On the other hand, the composite indicator approach may be distorted by the impact of one indicator and more importantly does not reveal the source of the poor performance.

This study attempts to outline a relatively simple statistical approach to identify those schools that can be described as poor performers. The paper employs data on the Barbadian secondary school system performance in English, Maths and all other subjects (Overall) over the period 1993-2006 to illustrate the utility of the approach.

This paper is structured as follows. After the introduction, the authors outline the methodological approach for evaluating school performance. Section 3 applies the approach to data from Barbados, which has a relatively successful high school programme. Section 4 summaries the main findings and presents some recommendations for implementing the approach.

2. Methodological Approach for Identifying Underperforming Schools

The approach presented in this paper is similar to that used by Anderson and Morrissey (2006) to identifying poorly performing countries. Assume that a school district has observations on indicators of performance for each school, for example average grades on Mathematics and English assessment examinations. One can employ three criteria to identify poorly performing schools: (1) absolute underperformance; (2) relative underperformance, and; conditional underperformance.

An absolute underperformer can be identified as any school that experienced a decline in average grades in assessment examinations. Conversely, good performers, would be those that obtained an improvement in the indicator over the period. This concept does not take into account the performance of other schools in the system. Maybe all students in a particular review period had

difficulty with assessment exams. In such an instance all schools would report lower average scores.

Alternatively, one can therefore use the concept of relative underperformance. A school is considered to be underperforming if the average level of performance in assessment exams is more than one standard deviation below the mean level of performance for all schools. Such an approach is similar to the benchmark approach identified in the previous section. However, rather than using arbitrarily chosen benchmarks, one employs the mean as the benchmark. By employing the mean, one is basically using a time-varying benchmark which changes based on the performance of other schools in the district.

The relative underperformance indicator does not take into account differences in initial endowments of some schools. In Barbados and the UK, for example, top students tend to cluster into 'grammar' schools. As a result, these schools tend to have better average performance. The conditional indicator of underperformance takes this into account by identifying a poor performing school as one where performance was one standard deviation below that expected given the initial level of the performance of the school. This can be done by estimating a regression of the form:

$$\Delta y_{it} = \alpha + \beta y_{it} + \varepsilon_{it} \qquad (1)$$

where Δ is a first difference operator, y is the performance indicator employed and ε is a well behave error term for each school i in period t. Poor performance is identified based on the error term using the criteria identified above.

The approaches identified earlier bear some similarity to the benchmark and the composite indicators approach. However, rather than basing underperformance on some arbitrary benchmarks or a vast array of indicators, one instead allows the data to identify those schools that show up on all three lists. One can then investigate the situations of these schools to identifying the challenges they encounter while trying to keep up with their peers.

3. An Application of the Approach to Barbados

3.1 Barbados' Secondary School System

Barbados is one of the few countries in the world where all citizens can access free education from primary to tertiary level. The educational system has historically been fairly successful in training students to enter the work force. Evidence of this success can be gleaned from the large number of Barbadians now working abroad and consequently repatriating foreign exchange to the country. Torres (1988) estimates the out-migration rate for Barbados at about 1.24 percent of the population annually. Although more recent estimates (2005) from the United Nation's Statistic Division suggest that this estimate has declined slightly to approximately 1 percent.

One of the most important components of Barbados' educational landscape is its secondary schools. Secondary schools are charged with the important responsibility of ensuring that all students obtain the knowledge, skills and attitudes necessary for their future careers. Most children of school age attend public schools or government-assisted private schools. There are 23 public secondary schools, most (21) of which co-educational institutions, and 6 government-assisted private secondary institutions.

Admission to the secondary school level is determined by three main criteria: (1) the student's performance in the Barbados Secondary Schools Entrance Examination (BSSEE); (2) parents' choice, and; (3) zones where the students live. The BSSEE is taken by all primary school students that have completed the national primary school curriculum (between 9 and 12 years) and tests students' ability in Mathematics, English and Essay writing. Before the BSSEE is done, the student's parent or guardian communicates their list of preferred schools to the Ministry of Education. If the student obtains the necessary grades, he/she can gain admission into one of the top three schools in the island, Harrisons College, Queen's College and Combermere, on academic merit alone. The remaining spots in these three schools (if any) and the other secondary schools are filled based on the list of preferred schools provided by the parent as well as the proximity of a given secondary school to the student (known as zoning).

The present system should, obviously, create a skewed distribution of secondary school performance. Added to this, prior to 2000, the BSSEE was the primary means of allocating students to various secondary schools. Under this system, those students obtaining similar grades were all sent to the same school. As a result, less that 6 of 23 secondary schools tended to obtain the best academic results in the secondary school leaving exams, currently known as the Caribbean Secondary Education Certificate (CSEC). The CSEC is administered by the Caribbean Examinations Council (CXC) and covers ten basic subject areas: agriculture; business education; home economics; humanities; industrial arts; industrial technology; information technology; modern languages; science and math, and; expressive arts. CXC employs a six-point grading scheme, with grade 1 being the highest attainable grade and grade 3 being considered an acceptable standard or a pass.

In addition to the introduction of partial-zoning to allocate students to secondary schools, one of the most important changes occurring in the systems was the introduction of the Education Sector Enhancement Programme, referred to as Edutech 2000. The programme, costing over US$200 million has the objectives of upgrading the physical infrastructure of all schools, upgrading (or installing) information technology infrastructure at all schools; human resource development and curriculum reform.

3.2 Data

The data used in this study is obtained from the Ministry of Education, Youth Affairs and Sports in Barbados. The key advantage of using observations on the Barbados secondary school system is that all secondary school students are required to take the same exams every year. As a result, this facilitates comparisons between schools. The raw files contained obtained observations on individual student performance on CSEC examinations in Barbados for various years. As indicated earlier, grades on CSEC take numerical values ranging from 1 to 6. The average student performance for each school is therefore calculated as mean CSEC grades in English, Mathematics and the average in all other CSEC courses taken. For expositional purposes, the average CSEC grades are inverted so that a higher value indicates better performance. The lowest possible value for this performance indicator is 0.167, where all students in the school received the lowest grade possible on CSEC examinations, while the highest possible value is 1, suggesting that all the students in the school received the maximum possible grade in all of their examinations.

Descriptive statistics for each school's performance is provided in Table 1. As expected, Combermere, Harrison College and Queens College, the top three grammar schools in the island, had the highest average overall performance over the sample. The superior performance of these three schools was primarily due to above average performances in English. Average grades in English for these three schools were approximately 36 greater than the mean for the other secondary schools. In the case of Mathematics, however, the difference between secondary schools was not very significant. The standard deviation of average school performance in Mathematics was 0.017 compared to 0.072 and 0.067 for Overall and English, respectively.

The table also calculates descriptive statistics for two seven-year intervals, 1993-1999 and 2000-2006, to identify any change in performance over time. Average performance of secondary school students declined somewhat during the 2000-2006 period. Only three schools recorded an improvement in average performance in Mathematics while seven schools had better average performance in English examinations. The difference between schools, particularly in English seems to be rising over time. While the standard deviation of average performance in English between 1993-1998 was 0.033, by the 2000-2006 period it had risen to 0.110. Evidence of this divergence of performances in English can also be gleaned by examining the differences between the average performance of the best and worst schools. The difference between the performance of the best and worst school rose from just 0.14 in 1993-1998 to 0.42 in the 2000-2006 period.

3.3 Classification

The statistics presented in the previous section provide only a snapshot of secondary school performance in Barbados. As mentioned earlier, the quality of students admitted to each school can impact on the evaluation of the performance of secondary schools. Obviously, if Combermere, Harrison College and Queens College are obtaining the best primary school students, the average performance of their student rolls in secondary school examinations should be better on average than other secondary schools. To account for these differences, this study employs three different criteria to rank schools: (1) absolute performance, (2) relative performance, and; (3) conditional performance.

Tables 2-4 present the results of applying the methodological approaches outlined earlier to data on Barbados' secondary school system. The tables provide the number of poor and good performers for each year based on the three criteria. In general, the tables show that the absolute performance approach, since it bases achievement on the difference in average grades between two periods, classifies a larger number of schools as underperformers. All three approaches presented in Table 2 reveal that there has been a decline in the number of poorly performing schools over time. In contrast, the relative performance method implies that the number of good performers has been fairly constant, while the absolute and conditional performance approaches suggests that the number of good performers is rising. Similar results are obtained when average performance in English and Mathematics examinations is employed (Tables 3 and 4).

Tables 5 lists the schools classified as poor performers based on all three criteria. Therefore all three performance criteria suggested that Coleridge and Parry's performance in 1994 was below

standard. There are two main findings that can be gleaned from the table. First, the number of schools classified as poor performers has been falling over time. Second, no single school consistently appears on the list every year. This indicates that those schools listed as poor performs have done an adequate job of ensuring that their performance does not remain below standard. It is noteworthy that no schools were classified as poor performers in English and Mathematics since 2001.

The schools identified as good performers are listed in Table 6. In terms of overall performance, Harrison College, Queens College and particularly Combermere consistently appear on the list of good overall performers. In terms of performance on English examinations, the three top schools are again consistently on the list, but other schools such as St. George, St. James, Alleyne, Garrison and Lodge also appear on the list in various years throughout the review period. The performance of the top three schools deteriorates somewhat when one examines the list of top performers in Mathematics. Harrison College, Queens College and Combermere only appear on the list once over the 13 year period. In contrast, Coleridge and Parry, Parkinson, Alexandra and Parkinson all appear on the list more than once.

4. Conclusions

The main goal of this study was to outline a relatively simple approach to identify underperforming schools. The approach outlined and illustrated in this study can be employed in small island countries such as Barbados or large districts. The utility of the framework is that it eliminates the ad hoc nature of most evaluation procedures and utilises purely statistical

techniques, eliminating any bias that may occur from differences in student backgrounds and the examinations employed to evaluate schools in each district.

The paper utilises three criteria to identify poorly performing schools: (1) absolute underperformance; (2) relative underperformance, and; conditional underperformance. Absolute underperformance occurs when the school experiences a decline in average grades, relative underperformance when the average level of performance is more than one standard deviation below the mean level of performance for all schools and conditional underperformance arises when performance was one standard deviation below that expected given the initial level of the performance indicator.

The criteria outlined above were applied to the Barbadian secondary school system over the period 1993 to 2006. In general, the absolute performance approach classifies a larger number of schools as underperformers, while the relative and conditional performance methods only identify those schools that have significantly different levels of performance relative to their peers. The approach provides fairly consistent results over different indicators of performance: Overall, English and Mathematics.

Using all three indicators, the number of schools classified as poor performers in Barbados has been falling over time. In terms of overall performance, the three top schools dominate the list of good performers, but have a less stellar performance in Mathematics. Harrison College, Queens College and Combermere only appear on the list once over the 13 year period. In contrast, Coleridge and Parry, Parkinson and Alexandra all appear on the list more than once.

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Table 1: Average School Performance in Barbados

Secondary School	1993-2006			1993-1999			2000-2006		
	Overall	Maths	English	Overall	Maths	English	Overall	Maths	English
Allexandra	0.362	0.328	0.382	0.376	0.350	0.378	0.347	0.306	0.386
Alleyne	0.358	0.326	0.364	0.380	0.344	0.373	0.335	0.308	0.356
Christ Church Foundation	0.382	0.331	0.393	0.404	0.360	0.379	0.359	0.301	0.406
Coleridge and Parry	0.345	0.335	0.358	0.363	0.366	0.377	0.328	0.304	0.339
Combermere	0.445	0.335	0.476	0.461	0.344	0.419	0.429	0.326	0.533
Deighton Griffith	0.326	0.309	0.359	0.346	0.330	0.381	0.308	0.293	0.340
Ellerslie	0.312	0.310	0.347	0.335	0.337	0.367	0.289	0.282	0.327
Garrison	0.298	0.303	0.335	0.324	0.335	0.363	0.273	0.271	0.307
Grantley Adams	0.296	0.309	0.327	0.313	0.338	0.366	0.278	0.281	0.271
Harrison	0.572	0.366	0.573	0.577	0.339	0.452	0.567	0.393	0.694
Louis Lynch	0.349	0.325	0.380	0.359	0.344	0.370	0.337	0.303	0.392
Parkinson	0.309	0.317	0.320	0.344	0.349	0.356	0.274	0.284	0.284
Princess Margaret	0.311	0.314	0.325	0.323	0.337	0.358	0.298	0.291	0.292
Queens College	0.502	0.350	0.532	0.503	0.340	0.452	0.502	0.360	0.613
Springer Memorial	0.306	0.316	0.330	0.326	0.346	0.369	0.286	0.285	0.291
St. George	0.291	0.310	0.330	0.304	0.355	0.378	0.277	0.265	0.282
St. James	0.316	0.316	0.347	0.345	0.338	0.410	0.286	0.293	0.284
St. Leonards	0.335	0.320	0.358	0.349	0.337	0.393	0.321	0.304	0.323
St. Lucy	0.347	0.300	0.351	0.378	0.314	0.402	0.316	0.283	0.300
Lester Vaughn	0.284	0.289	0.330	0.286	0.282	0.312	0.284	0.291	0.335
Lodge	0.371	0.316	0.390	0.399	0.332	0.420	0.343	0.300	0.361
St. Michael	0.413	0.331	0.415	0.433	0.336	0.424	0.392	0.326	0.407
Average	0.356	0.321	0.378	0.374	0.339	0.386	0.338	0.302	0.369
St. Deviation	0.072	0.017	0.067	0.069	0.017	0.033	0.076	0.029	0.110
Maximum	0.572	0.366	0.573	0.577	0.366	0.452	0.567	0.393	0.694
Minimum	0.284	0.289	0.320	0.286	0.282	0.312	0.273	0.265	0.271
Kurtosis	3.204	1.517	3.193	2.661	6.181	0.565	3.549	4.214	3.295
Skewness	1.780	0.824	1.904	1.553	-1.847	0.308	1.900	1.851	1.905

Table 2: Number of Poor Performers and Good Performers Overall

	Absolute		Relative		Conditional	
Year	No. of poor performers	No. of good performers	No. of poor performers	No. of good performers	No. of poor performers	No. of good performers
1993			4	4		
1994	9	13	4	4	5	2
1995	16	6	3	2	4	1
1996	9	13	2	3	3	0
1997	15	7	1	2	6	0
1998	21	1	0	3	21	0
1999	4	18	1	3	0	11
2000	9	13	1	3	0	10
2001	8	14	1	3	0	8
2002	9	13	0	2	1	4
2003	11	11	1	3	1	4
2004	10	12	1	3	1	4
2005	2	20	3	3	2	13
2006	11	11	2	2	1	3

Table 3: Number of Poor Performers and Good Performers in English

	Absolute		Relative		Conditional	
Year	No. of poor performers	No. of good performers	No. of poor performers	No. of good performers	No. of poor performers	No. of good performers
1993			4	5		
1994	9	13	3	3	2	3
1995	17	5	3	3	4	1
1996	4	18	2	6	3	4
1997	9	13	4	3	8	2
1998	18	4	0	4	11	2
1999	8	14	1	4	2	11
2000	13	9	0	3	0	3
2001	8	14	0	3	3	0
2002	14	8	0	3	4	0
2003	13	9	3	0	3	0
2004	5	17	2	1	0	6
2005	10	12	2	3	0	4
2006	14	8	4	2	5	0

Table 4: Number of Poor Performers and Good Performers in Mathematics

	Absolute		Relative		Conditional	
Year	No. of poor performers	No. of good performers	No. of poor performers	No. of good performers	No. of poor performers	No. of good performers
1993			4	4		
1994	12	10	5	1	12	0
1995	17	5	4	3	12	0
1996	18	4	3	2	9	0
1997	11	11	2	3	5	2
1998	21	1	2	2	20	0
1999	13	9	3	2	2	6
2000	2	20	1	2	1	16
2001	16	6	4	5	3	6
2002	6	16	6	4	0	13
2003	8	14	2	2	0	13
2004	16	6	3	2	0	8
2005	10	12	0	3	0	6
2006	9	13	5	3	3	0

Table 5: Poorly Performing Schools

Year	Overall	English	Mathematics
1993			
1994	Coleridge and Parry, Grantley Adams and St. George	St. George	Garrison, Princess Margaret, St. Lucy
1995	Princess Margaret	Princess Margaret	Ellerslie, St. Leonards and St. Lucy
1996			
1997		Grantley Adams	Lodge
1998			Grantley Adams
1999		St. James	
2000			St. George
2001			Garrison, Princess Margaret
2002			
2003			
2004			
2005	Deighton Griffith		
2006			

Table 6: Good Performing Schools

Year	Overall	English	Mathematics
1993			
1994	Harrison College and Queens College	Combermere and Queens College	
1995		Harrison College	
1996		St. George and St. James	
1997			Coleridge and Parry, St. Lucy
1998		Harrison College and Queens College	
1999	Combermere, Harrison College and Queens College	Alleyne, Garrison, St. George and Lodge	Parkinson
2000	Combermere and Queens College	Combermere, Harrison College and Queens College	Princess Margaret and St. James
2001	Combermere and Harrison College		Christ Church Foundation, Coleridge and Parry and St. Leonards
2002			Alleyne, Combermere, Louis Lynch
2003	Combermere		Alexandra and Parkinson
2004	Combermere		Alexandra and Deighton Griffith
2005		Combermere, Harrison College and Queens College	Harrison College, Queens College and St. Michael
2006			